

**A cloned *R* gene from *Phaseolus vulgaris* confers a systemic necrosis response to *Cucumber mosaic virus* in *Nicotiana benthamiana***

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*Bean dwarf mosaic virus* (BDMV) is a single-stranded DNA virus (Genus *Begomovirus*, Family *Geminiviridae*) that infects common bean (*Phaseolus vulgaris* L.) and causes stunted growth and mosaic symptoms. A Toll-interleukin-1 receptor (TIR)-nucleotide-binding site (NBS)-leucine rich repeat (LRR) resistance (*R*) gene analog (*RT4-4* gene) was cloned, using reverse transcription-PCR with degenerate NBS primers, from common bean (*Phaseolus vulgaris* cv. Othello) tissues undergoing a resistance response to BDMV. Northern blot and RT-PCR analyses revealed that *RT4-4* was expressed and upregulated in BDMV-infected tissues after inoculation of BDMV. A functional analysis of *RT4-4* was performed by generating transgenic *Nicotiana benthamiana* plants (susceptible to BDMV and many other viruses) and inoculating with DNA and RNA viruses. The *RT4-4* transgenic plants were not resistant to BDMV. However, these plants developed a systemic necrosis phenotype in response to infection by *Cucumber mosaic virus* (CMV; Family *Bromoviridae*, Genus *Cucumovirus*), a tripartite positive-sense RNA virus. These plants developed a systemic necrosis response to all the CMV isolates tested, except for a bean-infecting strain (strain 67). Of all the CMV strains instead, only strain 67 systemically induced cv. Othello, causing mosaic and dwarfing symptoms. Thus, the development of the systemic necrosis response of *RT4-4* transgenic *N. benthamiana* plants to infection with CMV strains was consistent with the relative susceptibility of cv. Othello from which the *RT4-4* gene was cloned. The finding that the CMV defense response elicited by *RT4-4* in *N. benthamiana* was very different from that in common bean, i.e., systemic necrosis versus no obvious symptoms, likely reflects the interaction of the *RT4-4* protein with different host factors and/or signal transduction pathways in these two plant species. Segregation analysis of T<sub>1</sub> transgenic plants indicated that the CMV systemic necrosis phenotype conferred by *RT4-4* acted as a single dominant gene. *Agrobacterium*-mediated transient expression experiments revealed that the CMV 2a protein (replicase) of the non-bean-infecting CMV strains was the elicitor of necrosis in the *RT4-4* transgenic *N. benthamiana* plants, whereas the 2a of the bean-infecting strain (67) did not induce necrosis. A single amino acid change in the 2a of a non-bean-infecting strain, changing phenylalanine to tyrosine at position 631, abolished the necrosis phenotype. These results are consistent with *RT4-4* acting in a gene-for-gene manner. Thus, *RT4-4* is a CMV *R* gene from common bean, which is functional across plant families.